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Research into Practice:

MATHEMATICS

Taking the Mystery Out Of Classroom-Based Formative Assessment

BY FRANCIS (SKIP) FENNELL AND JONATHAN A. WRAY

"It frankly took me years to figure out that the formative assessments that I use each day really impact my planning and teaching, and that planning, teaching, and assessing are very much connected. Now, I get it when people use the phrase 'assessing to inform'."

— 4th grade teacher

Formative Assessment—What Is It?

The importance of formative assessment has been discussed for decades. Scriven (1967) and Bloom (1969) were early advocates of the potential of formative evaluation to improve instruction. Based on their review of hundreds of studies, Black and Wiliam (1998) defined formative assessment as "encompassing all those activities undertaken by teachers and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged" (p. 7). Formative assessment includes all actions that provide information to be used as feedback to modify teaching and learning. The focus of this white paper is on the everyday importance of classroom-based formative assessments as links to planning and instruction. The phrase "assessing to inform" is what classroom-based formative assessment is all about.

"I just figured our school or the district bought formative assessment tests to use every once in a while. It took me a while to realize that I'm in charge, and formative assessment is part of my planning and teaching—every day."

— elementary classroom resource teacher

Formative Assessment—Why Is It Important?

When you analyze student responses to any assessment, you estimate the value of the response and use that to determine what students know, understand, and are able to do. This defines your everyday use of assessment to both determine student progress and influence your planning and instruction. In any given year of teaching, your understanding of what each of your students knows and is able to do increases daily. Much of what you do assessment-wise is, or should be, directly related to what you teach each day. *Principles to Actions* (NCTM, 2014), notes that "...assessment is an integral part of instruction, provides evidence of proficiency with important mathematics content and practices, includes a variety of strategies and data sources, and informs feedback to students, instructional decisions and program improvement" (p. 89).

Formative Assessment—What Strategies Make It Effective?

Formative assessment is connected to your planning and teaching each and every day. *You own this!* Linda Darling-Hammond (1994) noted that "in order for assessment to support student learning, it must include teachers in all stages of the process and be embedded in curriculum and teaching activities" (p. 25).

Wiliam and Thompson (2007) suggest that the effective use of assessment for learning consists of five key strategies:

1. **Clarifying and sharing learning intentions and criteria for success with learners:** This is all about unpacking the intended learning goals of your lesson and determining the mathematical tasks and related activities that will lead to the expected learning. This strategy emphasizes the importance of anticipating how students will be engaged in the mathematics they are learning.
2. **Engineering effective classroom discussions, questions, and learning tasks that elicit evidence of students' learning:** This assessment strategy considers how you will develop classroom activities that not only engage students in doing mathematics, but also provides evidence of student progress toward your intended mathematical goal or goals of the day. The emphasis here is on finding the time to plan such lessons, with particular consideration for how you will assess student progress.
3. **Providing feedback that moves learners forward:** As you teach and regularly use formative assessment techniques, the feedback you provide to your students is critical. In addition, student mathematical engagement and their responses provide you with feedback regarding student progress as well as the success of particular aspects of your lesson and teaching. When considering the feedback you provide to students, it's important to monitor what they do with it. Does the feedback prompt students to try a different strategy, to work more carefully, to examine aspects of a task they may have misunderstood? Perhaps the feedback you provide affirms a student's response. As you use formative assessment to monitor your students as they engage in learning mathematics you will regularly provide them with personalized feedback.
4. **Activating students as owners of their own learning:** Using formative assessment to monitor teaching and learning connects assessment, very directly, to planning and instruction. Your students are, very much, part of this equation. Engaging students in their learning of mathematics includes their active participation in monitoring and guiding their own learning. Such student ownership and self-assessment opportunities will influence the pace of your lessons and also have you decide when to use particular formative assessment techniques. Your use of the classroom-based formative assessment techniques presented in this white paper will include your students as active learners and fully engaged self-assessors.
5. **Activating students as instructional resources for one another:** The formative assessment potential of peer review and feedback is in developing responsible collaboration among students. Students learn from each other. They are often more willing to accept feedback from a peer than from adults (e.g., teachers, parents . . .). As students are engaged in doing mathematics, time must be provided for them to share their "work in progress" efforts, those first draft solutions to tasks, their preliminary drawings of particular representations when, for instance, comparing fractions, or their rationale for solving a problem.

What we know about formative assessment is that student achievement can be improved when teachers regularly, as in every day, both within and between lessons, connect it to planning and instruction. This white paper addresses what Wiliam and Thompson (2007) have defined as short-cycle formative assessment—day-by-day and minute-by-minute.

"Admittedly, it took a while, but each night when I plan for the next day, part of that planning involves my intended use of particular formative assessment techniques. Within a lesson and at the end of the day, it's my 'read' on those assessments that jump starts my planning for the next day."

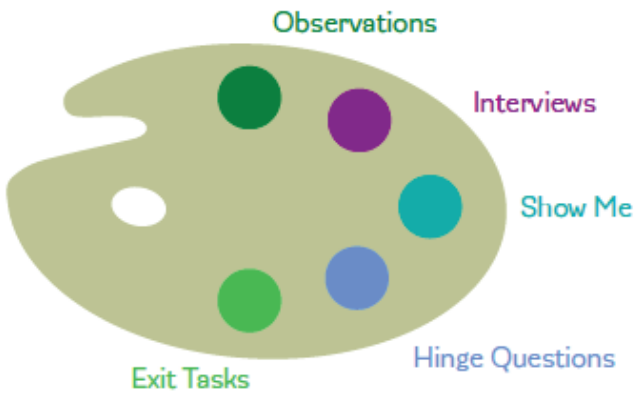
— middle school mathematics teacher

Formative Assessment Every Day: The Formative 5

The day-by-day classroom-based formative assessment focus of this white paper is on the use of five formative assessment techniques that you can use each day to validate and build on prior assessments to guide your planning and teaching. Use of the following classroom-validated formative assessment techniques will help you to monitor student progress within a lesson as well as your own next steps instructionally.

Think about the following classroom-based assessment techniques metaphorically as an artist's palette of 5 "colors" that you, each day in your classroom, can use as you create your own classroom canvas. Let's consider these techniques"

— The Formative 5 *(Fennell, Kobett, & Wray, 2017).*



Source: Fennell, Francis (Skip), Beth McCord Kobett, & Jonathan A. Wray (2017). The Formative 5: Everyday Assessment Techniques for Every Math Classroom. Thousand Oaks, CA: Corwin

Figure 1. This palette represents the Formative 5 techniques presented in this white paper.

OBSERVATIONS

As a classroom teacher, you already observe your students every day. This assessment technique, while often viewed as more informal than others, is of particular importance as you monitor student engagement within mathematics lesson activities. As you use observation as a classroom-based formative assessment technique, the following questions will be helpful to you in your day-to-day planning.

1. **Anticipate:** What is it that you hope to observe your students doing in this mathematics lesson?
2. **Look for:** How will you know "it" if you saw it?
3. **Opportunities/Challenges:** Are there particularly unique or advanced representations and/or solutions you might observe? Are there student misconceptions that you might observe?
4. **Feedback:** How will you record what you observe and provide feedback to your students?

Within the ***enVision®*** *Mathematics ©2024* program, the Solve & Share problems provide an opportunity in every lesson to use the Observations technique.

Consider using tools like these as you plan for and use observations as a formative assessment technique.

Planning: Observations Template

Mathematics Standard:			
Lesson Objective:			
What would you expect to observe?	**How would you know "it" if you saw it?**	**What mathematical challenges or misconceptions might you observe?**	**How might you record and provide feedback of what you observe?**

Images: Clipart.com

Figure 2. ***Planning Tool:*** *This tool will be helpful to you as you anticipate what you may observe within a lesson, including considerations regarding possible student use of representations, misconceptions and feedback.*

Classroom: Observation—Student Representations

Student Representations (Anticipated/Observed)	Who Is Using Specific Representations	Who I Will Select to Share Their Representations (order of presentations; 1st, 2nd, . . .)
Anticipated:		
Observed:		
Observed:		
Observed:		
Observed:		

Source: Adapted from Smith, M. S., & Stein, M. K. (2011). *5 practices for orchestrating productive mathematics discussions.* Reston, VA: National Council of Teachers of Mathematics.

Figure 3. ***Student Representations:*** *Consider using this tool as you monitor student responses to an assigned task, and then determine, based on what you have observed, the order of student presentations.*

INTERVIEWS

An interview extends an observation. It's that next, deeper, "wonder about" step you take as you observe, and it's very much connected to the observation as a formative assessment technique that truly monitors a lesson. An interview allows you to spend a few valuable minutes digging deeper with an individual student or perhaps a small group of students. The intent of the interview is to get a glimpse of what students are actually thinking. The following questions will help guide your use of the interview technique.

1. **Purpose:** What would make you decide to work with a student one-on-one or with a small group of students?
2. **Questions:** What questions might you ask? How might the questions be different for particular students?
3. **Responses:** What might you anticipate from the students response-wise? (Consider both understandings and possible errors/ misconceptions.)
4. **Follow-up:** As students respond, what follow-up questions might you ask?
5. **Feedback:** How will you provide feedback during and at the conclusion of the interview?

Within the ***enVision®*** *Mathematics ©2024* program, the Solve & Share problems also provide an opportunity in every lesson to use the Interviews technique.

Consider using tools like this as you plan for and use interviews as a formative assessment technique.

Individual Student: Interview Prompt

Interview Prompt*		
Name:	**Date:**	**Math Topic:**

Question	Student Responses
1. How did you solve that?	
2. Why did you solve the problem that way?	
3. What else can you tell me about what you did?	

**Note:* Attach completed work sample(s).

Figure 4. ***Interview Prompt:*** *This tool is often used to frame the questions within an interview as well as provide a record of student responses.*

SHOW ME

The Show Me technique has the potential to extend both as an observation and an interview and occurs when a student, pair of students, small group, or perhaps the entire class may be asked to show how a particular technique works, how a problem is solved, how a particular representation could be constructed (e.g. using bar diagrams to compare fractions), etc. Teachers who use this technique indicate that the Show Me validates what may have been observed and often provides an opportunity for a redirected or extended response (e.g., "Show me what that would look like if the side lengths were doubled."). Use of the Show Me technique is often serendipitous. You observe a student response and may ask, "Show me how you did that" "Show me what would happen if…". This technique both deepens and sharpens your understanding of what students know and are doing at a particular moment within a lesson.

Some questions to consider regarding use of the Show Me technique include the following:

- What particular aspects of a lesson (e.g. using bar diagrams to compare fractions) would be most conducive for using the Show Me?
- How or when might you use the Show Me technique with a small group or the entire class?
- How might you organize your classroom for implementing the Show Me technique (e.g. access to materials)?

Within the grades K-2 ***enVision®*** *Mathematics ©2024* program, the Solve & Share problems provide an opportunity in every lesson to use the Show Me technique. Within the grades 3-5 program, the Solve & Share as well as the Guided Practice, in particular the Do You Understand? and Do You Know How? problems, lend themselves to use of the Show Me technique.

HINGE QUESTION

The hinge question (Wiliam, 2011) provides a check for understanding/proficiency at a "hinge point" within a lesson. It's a question that you will plan for and use, typically, but not always, toward the end of a lesson. Student responses and your analysis of the hinge question(s) responses truly guide your next steps—planning-wise and instructionally. Planning for and creating the hinge question is an important component for the planning of the day's lesson.

In our work with *The Formative 5*, we note that teachers have found it helpful to try out draft hinge questions with colleagues before actually using them. We have also found that teachers edit, electronically save, and revise hinge questions from year-to-year. Considering how you will engage students, assess responses, provide feedback, and decide instructional next steps attests to both the value and importance of the hinge question. Consider the following questions and Figure 5 to help guide your development and use of hinge questions:

- Will you use multiple hinge (hinge point) questions or a single hinge point question?
- Will your hinge question be multiple choice, in format, or be presented as an open-ended question?
- How will you plan for involving most students in the hinge question response and quickly receive and analyze responses?

Within the grades K-2 ***enVision®*** *Mathematics ©2024* program, the Independent Practice problems provide an opportunity in every lesson to use the Hinge Question technique. Within the grades 3-5 program, the Guided Practice, in particular the Do You Understand? and Do You Know How? problems, could be adapted and used as Hinge Questions.

Consider using tools like this as you plan for and use hinge questions as a formative assessment technique.

Planning: Hinge Question Considerations Tool

Date:

Hinge Question:

	Yes	No
Will the hinge question assess important mathematical understandings of the day?		
Will students understand the question?		
Will students be able to respond in about a minute?		
Will expected responses be such that they can be analyzed and interpreted quickly?		

General Consideration: Will responses assist in shaping planning for tomorrow's lesson?

Circle one: Yes No (If no, revise hinge question)

How?

Source: Fennell, F., Kobett, B., & Wray, J. (2015). Classroom-based formative assessments: Guiding teaching and learning. In C. Suurtamm (Ed.) & A. McDuffie (Series Ed.), *Annual perspectives in mathematics education: Assessment to enhance teaching and learning* (pp. 51–62). Reston, VA: National Council of Teachers of Mathematics. Republished with permission of the National Council of Teachers of Mathematics; permission conveyed through Copyright Clearance Center, Inc.

Figure 5. ***Hinge Question Planning:*** *Planning the hinge question, including the consideration of its format (multiple choice or open response) is important. This tool is popularly used to address considerations for a hinge point question and guide the planning of such questions.*

EXIT TASKS

In our efforts to determine particularly impactful classroom-based formative assessment techniques, we decided that the exit task would serve as an end-of-lesson formative assessment, which may, potentially, guide both short term and long-term planning. We deliberately defined these as exit tasks, given our experience with the popular, and seemingly narrowly focused, use of exit tickets or exit slips. The exit task is a capstone problem or task that captures the major focus of the mathematics lesson for that day or perhaps the past several days. Since the exit task's solution and related work is actually a product, this provides actual student responses for you to review and use for future planning. As with the Hinge Question, you will need planning time to locate or develop Exit Tasks. In our work with schools and school districts using *The Formative 5*, we have found that grade level or grade-band teams often collaborate on locating and/or creating exit tasks and then revising them, as needed. We have also noted that given the amount of time needed to implement, analyze task responses, and provide feedback to students, use of the exit task will typically occur several times a week, but not daily. The following questions will help guide your use of the exit task technique:

1. Does the exit task capture the mathematical content expectation of the lesson?
2. Given the grade/course level, classroom norms, and prior experience working with challenging mathematical tasks, will this exit task engage your students?
3. Should the exit task be completed by individual students, student pairs, or small groups?
4. When will you be able to review exit task responses, use the responses to guide your planning, and provide feedback to your students?

Within the grades K-2 ***enVision®*** *Mathematics ©2024* program, the Independent Practice problems provide an opportunity in every lesson to use the Exit Tasks technique. Within the grades 3-5 program, the Math Practices & Problem Solving problems may be adapted and used as Exit Tasks.

Consider using tools like this as you plan for and use exit tasks as a formative assessment technique.

Planning: Exit Tasks Tool

Date:	Mathematics Standard:	Task Level (circle one): Lower Level Demand (Memorization) Lower Level Demand (Procedures Without Connections) Higher Level Demand (Procedures With Connections) Higher Level Demand (Doing Mathematics)
Grade Level:	Mathematical Practices:	
Task:		
Expected Response:		
Summary of Class Responses:		
My Planning—Next Steps:		

Figure 6. ***Exit Task Planning:*** *When planning an exit task, considerations include the mathematics standard and mathematical practice(s) being assessed as well as the task's level of demand (Smith and Stein, 1998). This tool guides you through actual planning and use of an exit task.*

Day-by-Day Formative Assessment—You Can Do This In Your Classroom!

A focus of this white paper has been on the use of five classroom-tested formative assessment techniques to inform planning and teaching. As indicated earlier, feedback to students and your reflective analysis of student progress, which provides feedback to you, truly impacts your planning and teaching.

WHAT ABOUT TEACHER PLANNING AND FORMATIVE ASSESSMENT?

The intent here is to provide you ways to every day connect the use of formative assessment to planning and teaching. This means that planning for the use of Observations, Interviews, Show Me, Hinge Questions, and Exit Tasks occurs regularly and is very much an element of lesson planning. Recognize that particular features within the ***enVision®*** *Mathematics ©2024* program would be wonderful opportunities for their use. Figure 7 below provides a summary of such opportunities.

F5 Opportunities within enVision® Mathematics ©2024

F5 Technique	K-2	3-5	6-8	High School
Observations	Solve & Share	Solve & Share	Solve & Discuss It	Model & Discuss
Interviews	Solve & Share	Solve & Share	Solve & Discuss It	- Model & Discuss - Habits of Mind
Show Me	Solve & Share	Solve & Share Guided Practice: - Do you understand? - Do you know how?)	- Solve & Discuss It - Convince Me! - Do you understand? - Do you know how?	Model & Discuss
Hinge Questions	Independent Practice	Guided Practice: - Do you understand? - Do you know how?)	- Do you understand? - Do you know how? - Practice & Problem Solving	- Do you understand? - Do you know how? - Practice & Problem Solving
Exit Tasks	Higher Order Thinking	Math Practices & Problem Solving	Practice & Problem Solving	- Do you understand? - Do you know how? - Practice & Problem Solving

Figure 7. Table of lesson features within ***enVision®*** *Mathematics ©2024, organized by Formative 5 technique.*

So, for example, as any lesson is being planned, what might be observed as students completed the Solve & Share problem? When might the interview and/or Show Me occur within the lesson? When would you insert the Hinge Question and Exit Tasks and have you provided the planning time to create or locate them? Connecting what you will assess and the techniques you will use to formatively assess are essentially ways in which you anticipate how students will be engaged in doing the mathematics within the day's lesson. It's important to note that the tools provided here and other print and online tools can be used to assist you in the planning process. Such tools can be used to help you in, for example, framing Exit Tasks, or in record keeping related to student progress via Observations, Interviews, Show Me, Hinge Questions or Exit Tasks. Your everyday use of formative assessment begins with the planning of the day's mathematics lesson.

WHAT ABOUT FEEDBACK AND GRADING?

The importance and purpose of classroom-based formative assessment, which includes providing feedback to students, is to help guide instruction and learning, not to provide opportunities for grading or grades. As you observe or use an interview or Show Me you will be monitoring student progress and determining your next steps instructionally. Grading such responses would be inappropriate. Similarly, your use of a hinge question, assesses student progress within a lesson to provide indicators of student progress and, once again, determine your next steps, instructionally. In our work with teachers using *The Formative 5*, we have found that some teachers score exit tasks, or save exit task responses to share at parent-teacher conferences. While this may be appropriate, it should be noted, once again, that the intent of *The Formative 5* is to embed assessment within the planning and teaching cycle to everyday monitor and address student learning and guide planning and instruction.

Final Thoughts

While formative assessment is discussed, even heralded, as an important aspect of the teaching and learning process, it continues to be a challenge implementation-wise. The intent of this white paper has been to identify classroom-tested formative assessment techniques that you can implement to enrich your mathematics classroom on a day-to-day basis. After all, you assess student progress all day, every day. You may not have thought about the potential power of your classroom observations, recognized the value of interviewing, or considered the Show Me and Hinge Questions techniques. These techniques are all connected. They naturally occur as you plan, and then teach. You use these techniques to regularly monitor student progress. A critical consideration for using Observations, Interviews, Show Me, Hinge Questions, and Exit Tasks is for you to anticipate student responses. In essence as you plan you will need to anticipate what you might observe, how students might respond to an interview or Show Me, their hinge question responses, and the quality and type of responses to your exit tasks. Such anticipation is the link which connects planning, teaching, and your use of *The Formative 5's* palette of classroom-based formative assessment techniques: Observations, Interviews, Show Me, Hinge Questions, and Exit Tasks.

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